Executive Summary for Diazinon ESA Assessment

This Biological Evaluation (BE) assesses whether the registered uses of diazinon (PC code 057801), based on the U.S. Environmental Protection Agency's (EPA) proposed federal action, will result in a potential effect to an individual of an endangered and threatened (listed) species and/or designated critical habitats. The evaluation also includes analysis of impacts to candidate species as well as species and critical habitat proposed for listing for conferencing purposes under section 7 of the Endangered Species Act (ESA). This evaluation, conducted as part of the registration review process (EPA's action under consultation), is based on interim scientific methods developed in response to recommendations of the National Research Council (NRC, 2013) and uses a three-step consultation process.

Step 1 consists of two parts: 1) establishing the action area for the proposed action, and 2) overlaying the listed, proposed, and candidate species (hereafter, "listed species" ranges and proposed and final critical habitat designations (hereafter, "critical habitat(s)" onto the action area (**Section 1.4.1**). This step identifies which species and critical habitats have the potential to be affected by the proposed action. A "no effect" determination is made for species and critical habitats whose ranges do not overlap with the action area and listed species that are presumed extinct (or extirpated from specific geographic areas). Any listed species and/or critical habitat that warrants a "may affect" determination in Step 1 (*i.e.,* its range and/or critical habitat overlaps spatially with the action area and it is not presumed extinct or extirpated from the US) continues for further analysis in Step 2. Step 2 determines whether effects to individuals of listed species and/or Primary Constituent Elements (PCEs)/physical and biological features (PBFs) of critical habitat result in a "may affect, not likely to adversely affect (NLAA) determination, or a "may affect, likely to adversely affect" (LAA) determination. In Step 2, toxicity (indirect and direct effects data) and exposure information are analyzed using a weight-of-evidence (WoE) approach. These data are organized into lines of evidence that inform risk hypotheses and ultimately the effect determinations for listed species and their critical habitats. The NLAA determinations are submitted to the US Fish and Wildlife Service and the National Marine Fisheries Services (the Services) for concurrence, while the listed resources with a LAA determination are considered by the Services in their Biological Opinions (Step 3). This Biological Evaluation represents Steps 1 and 2 in the ESA pesticide consultation process for diazinon.

General Information

Diazinon is an insecticide used on orchards (almonds, stone fruit and pome fruit), ground fruit and vegetable crops (e.g., lettuce, tomatoes), outdoor nurseries and cattle ear tags. While most of the uses are allowed across the United States, many of the labeled uses are on Special Local Needs (SLN) labels and are only allowed in one state. Based on an Office of Pesticide Programs Information Network (OPPIN) query (conducted December 2014) there are five registrants with diazinon products with three technical labels, six Section 3 labels for agricultural products applied to crops, ten 24C or SLN Labels that are supplements to the six Section 3 labels, six cattle ear tag labels, and one Section 18 label for control of the fruit fly in the *Tephritidae* family in Florida. (see **APPENDIX 1-2**). All agricultural products (except the cattle ear tag) are applied in liquid form. Aerial applications are allowed for use on lettuce only. For all other uses, ground application methods (including broadcast, soil incorporation, orchard airblast, and chemigation) are allowed (see **APPENDIX 1-3** for details).

Diazinon enters the environment via direct application to use sites. It may move off-site via spray drift, volatilization (primarily following foliar applications), and runoff. Major routes of diazinon

transformation in the environment are through metabolism in soil and aquatic environments. In air, diazinon transforms to diazoxon, which is a degradate of concern. In soil and water, diazinon transforms to oxypyrimidine, which is not of toxicological concern (the toxicity is orders of magnitude lower than diazinon; see **APPENDIX 1-9**).

Diazinon is an organophosphate insecticide used to kill insects systemically and on contact. Organophosphate toxicity in animals is based on the inhibition of the enzyme acetylcholinesterase (AChE). Inhibition of AChE interferes with proper neurotransmission in cholinergic synapses and neuromuscular junctions which can lead to sublethal effects and mortality. The effects of diazinon have been studied extensively in many taxa, particularly in fish and invertebrates (see **Chapter 2**). The BE considered more than 500 ecotoxicity studies for diazinon (including approximately 130 fish studies, 10 amphibian studies, 130 aquatic invertebrate studies, 10 aquatic plant studies, 80 bird studies, 1 reptile study, 70 mammalian studies, 170 terrestrial invertebrate studies, and 60 terrestrial plant studies). Studies include acute and chronic laboratory studies with either technical or formulated diazinon, and include both registrant-submitted and open literature studies (search of relevant open literature data conducted up through June 2013). Toxicity to taxa from exposure to other chemical stressors of concern (*i.e.*, diazoxon, mixtures [*e.g.*, tank mixtures, formulated products, and environmental mixtures]) and non-chemical stressors (*e.g.*, temperature) are also considered.

Exposure Methods

Exposure values are based primarily on fate and transport model results. For aquatic exposures, the Pesticide in Water Calculator (PWC, v. 1.52, May 2016) [a new graphical user interface used to run Pesticide Root Zone Model (PRZM)/Variable Volume Water Body Model (VVWM)], and AgDRIFT models are used to predict aquatic exposure in generic habitats, referred to as bins (see **Section 1.4.2.2.a.1.**). Aquatic exposure results for the bin(s) most appropriate for the species and/or critical habitat being assessed are used. For terrestrial exposures, existing models [*i.e.,* Terrestrial Residue Exposure model (T-REX), Terrestrial Herpetofaunal Exposure Residue Program Simulation (T-HERPS), portions of the Terrestrial Investigation Model (TIM), TerrPlant, and AgDRIFT] were combined into a single tool that is referred to as the Terrestrial Effects Determination tool (TED) (see **Section 1.4.2.2.a.2.** and **ATTACHMENT 1-7**). A more detailed analysis using TIM and the Markov Chain Nest Productivity Model (MCnest) is also conducted for a subset of listed bird species. The models used in this BE can be found at [HYPERLINK "https://www.epa.gov/endangered-species/provisional-models-endangered-species-pesticide-assessments"].

Overlap Analyses

For diazinon, potential use sites were represented by 4 different types of landcover: orchards, ground fruit and vegetables, nurseries and areas where cattle graze. Of these landcovers, nurseries has the smallest overlap with species ranges. The majority of listed species ranges overlap with landcovers representing agricultural uses of diazinon (i.e., orchards, ground fruit and vegetables).

Effects Determinations

To help determine the potential for risk, effects thresholds are established (see Interim agreement[1]). For mortality to animals, the one-in-a-million chance of mortality [based either on the 5th percentile of the Species Sensitivity Distribution (SSD) or a surrogate LD_{50}, LC_{50}, or EC_x] is used to assess direct effects to a listed species (for details, see **ATTACHMENT 1-4**). For potential indirect effects based on prey lethality for those species without obligate relationships, the exposure that results in a 10% effect for the 5th percentile species on an SSD for the prey species or the 10% effect level for the most sensitive prey species tested (if not enough data are available for a SSD) is used. For sublethal effects, the direct effects threshold for animals and plants is the lowest available NOAEC/NOAEL or other scientifically defensible effect threshold (EC_x) that can be linked to survival or reproduction. For animals, the indirect effects threshold is the LOAEC/LOAEL for growth or reproduction for relevant taxa. For plants and indirect effects, the threshold is the lowest available LOAEC or EC_{50} value (aquatic plants) and the lowest LOAEC or EC_{25} value (terrestrial and wetland plants). These thresholds are used with other available data in a weight-of-evidence (WoE) approach which integrates the body of evidence that is available for making an effects determination. For the exposure assessment, the overlap of species range and action area, the relevance of predictive models to simulate EECs, the quality of fate data for exposure modeling and monitoring data that may be available are considered. For the effects analysis, the number of studies and/or species tested in the available toxicity data, taxonomic surrogacy, the magnitude and/or types of effects observed, and incident data are considered. An overall risk finding (high, medium, low) and a finding on the overall confidence (high, medium, low) in the available exposure and effects data is made for each line of evidence to inform the effect determinations for listed species and critical habitats (see **ATTACHMENT 1-9**).

Effects Determinations Summary

For diazinon, the results of the Step 1 ('**No Effect**' (NE) or '**May Affect**' determinations) and Step 2 ('**Not Likely to Adversely Affect**' (NLAA) or '**Likely to Adversely Affect**' (LAA) determinations) for species and designated critical habitats are presented in **Tables 1 and 2**, respectively. For species/critical habitats with a NE determination in Step 1, no additional analyses are conducted (they do not proceed to Step 2). In Step 2 analyses, all of the diazinon uses and use patterns modeled result in threshold exceedances for most taxa. For species/critical habitats with NLAA determinations, they will be sent to the Services for concurrence. For species/critical habitats with a LAA determination, additional analyses will be conducted (*i.e.*, they proceed to Step 3).

[1] Interim approaches and agreement: [HYPERLINK "https://www.epa.gov/endangered-species/interim-approaches-pesticide-endangered-species-act-assessments-based-nas-report"]

TABLE 1. Summary of Species Effects Determinations for Diazinon (Counts by Taxon).

TAXON/ CRITICAL HABITAT	STEP 1 EFFECTS DETERMINATIONS		STEP 2 EFFECTS DETERMINATIONS	
	NO EFFECT[1]	MAY EFFECT[2]	NOT LIKELY TO ADVERSLY AFFECT[3]	LIKELY TO ADVERSELY AFFECT[4]
Amphibians	0	40	2	38
Aquatic Invertebrates	5	215	7	208
Birds	7	101	19	82
Fish	0	193	23	170
Mammals	3	106	25	81
Plants	69	892	199	693
Reptiles	1	47	0	47
Terrestrial Invertebrates	29	126	9	118
TOTALS	114	1720	284	1437

[1] No further analyses is conducted for these critical habitats

[2] These species proceed to Step 2

[3] These species determinations go to the Services for concurrence

[4] These species proceed to Step 3

TABLE 2. Summary of Designated Critical Habitat Effects Determinations for Diazinon (Counts by Taxon).

TAXON/ CRITICAL HABITAT	STEP 1 EFFECTS DETERMINATIONS		STEP 2 EFFECTS DETERMINATIONS	
	NO EFFECT[1]	MAY EFFECT[2]	NOT LIKELY TO ADVERSLY AFFECT[3]	LIKELY TO ADVERSELY AFFECT[4]
Amphibians	2	23	2	20
Aquatic Invertebrates	3	72	7	65
Birds	5	26	4	22
Fish	0	106	9	97
Mammals	2	30	8	23
Plants	59	403	280	123
Reptiles	2	15	5	10
Terrestrial Invertebrates	10	36	11	25
TOTALS	83	711	326	385

[1] No further analyses is conducted for these critical habitats

[2] These species proceed to Step 2

[3] These species determinations go to the Services for concurrence

[4] These species proceed to Step 3